TPS61310EVM-638 Evaluation Module User Guide

This user's guide describes the characteristics, functions, and use of the TPS61310EVM-638 Evaluation Module (EVM). This EVM demonstrates the Texas Instruments TPS61310 LED camera flash and video light driver with I2C interface. This document includes setup instructions, a schematic diagram, a bill of materials and PCB layout drawings for the EVM.

1 INTRODUCTION

The TPS61310 is an integrated system with a broad feature set for driving up to three LEDs for still-camera flash and video-camera lighting applications. The power stage is capable of supplying a maximum total current of up to 1600mA (2x400mA for LED1 and LED3, 800mA for LED2).

The device operates as an single, dual or triple channel LED driver generating the required LED forward voltages. The internal step-up converter boosts the input voltage adjusted to the required LED forward voltage and controls the LED current with the integrated current sinks.

The internal step-up converter can be used for further applications as well, such as supplying an audio amplifier.

All functions and feature sets can be either addressed by dedicated hardware pins or with the I^2C interface.

1.1 Requirements

To operate this EVM, connect and properly configure the following components:

- Personal Computer:
  - OS: Windows™ 2000 or Windows™ XP
  - USB port
  - Minimum of 30MB of free hard disk space (100 MB recommended)
  - Minimum of 256MB of RAM
- Printed Circuit Board Assembly:
  - The board containing the TPS61310 in CSP-20 package.
  - External components
  - High power WLEDs
- USB-To-GPIO Adapter:
  - This USB interface adapter is used to evaluate the I^2C controlled device via a personal computer using the USB interface. It receives the USB command, converts the signal into an I^2C protocol and sends the I^2C signal to the TPS61310EVM board. The USB-To-GPIO can be supplied at the following URL: ti.com
- Software:
  - Texas Instruments provides software to assist in evaluating this EVM. The software can either be installed from the supplied CD or download from the TI Web site

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2 HARDWARE SETUP

This section describes the jumpers and connectors of the EVM and how to properly connect, set up and use the TPS61310EVM-638.

2.1 EVM Hardware Setup

Table 1. Board Input/Output Connector Descriptions

Jumper/Connecter	Function
J1 – VIN/GND	J1 is for the IC positive input supply voltage and ground. The leads to the input supply should be twisted and kept as short as possible to minimize EMI transmission and reduce inductive voltage droop during a load-transient event. V_{IN} should be between 2.5V and 5.5V.
J2 – VOUT/GND	J2 is connected to the device output and GND pins. In flash or movie mode, V_{OUT} is connected to the LED anodes and can be used to access the high-side LED voltage. In voltage regulation mode, the header can be used to measure the regulated output voltage and connect an external load.
J3 – VOUT/LED1/LED2/TS/GND	These headers support external LEDs. The LED1 and LED2 headers link the LED cathodes to the device current sinks. The LED anodes are connected to the VOUT output. The TS header is provided for the NTC resistor (220kΩ) connection.
J4 – SCL/SDA/GND	J4 is connected to the device I^2C SCL and SDA. The serial clock and data line can be used to monitor the traffic between the PC and the EVM or set up I^2C communication.
J5 – I^2C Input for the USB-To-GPIO	J5 provides a link to the USB-To-GPIO 10-pin ribbon cable interface. The included software uses the adapter to communicate with the EVM via the I^2C protocol.
J6 – I^2C Input for the MSP430 USB-Debug-Interface	J6 is a 14-pin JTAG interface. It links the device to the MSP430 USB debug interface. The MSP430 embedded software uses the adapter to communicate with the EVM via the I^2C protocol.
JP1 – I^2C Pull-Up	This jumper is used to connect the SCL and SDA to two 2.2kΩ pull-up resistors. These resistors are either linked to the board input voltage or to ground. In normal use, the I^2C pull-up resistor should be connected to Vin. This configuration is due to the I^2C open-drain architecture.
JP2 – TS	JP2 is employed if the LED temperature is not monitored. In this case, the TS input should be tied to Vin.
JP3 – nReset	The nReset jumper is directly linked to the device hardware reset input. If this pin is LOW, the device is forced to shutdown mode, and the I^2C control and all internal control registers are reset. Otherwise, if nReset = HIGH, the device operates normally.
JP4 – Tx-Mask	JP4 is connected to the RF PA synchronization control input of the TPS61310. Tying this input HIGH switches the LED current from flash to video-light operation. In video-light mode, the peak current drained from the battery is significantly reduced.
JP5 – STRB1	JP5 selects the LED current to a high or low level. If the low current level is selected, the flash mode is enabled. In the other configuration, the video light mode is selected.
JP6 – STRB0	JP6 sets STRB0 to Vin or to GND. If STRB0 is HIGH, all the LED current regulators are activated.
JP7 – GPIO/PG/XINT	The middle pin of JP7 is connected to GPIO/PG on the TPS61310. The jumper is used to set GPIO to a high or a low level.
JP8 – Pull-up Resistor	JP8 allows connecting the GPIO/PG pull-up resistor to Vin. It is used to avoid setting a high level when the GPIO pin is not used.
JP9, 10 and 11 – Output current evaluation	These jumpers facilitate LED current measurements.

Table 2. Default Jumper Settings

JUMPER	DEFAULT
JP1	High
JP2	Unconnected
JP3	High
JP4	Low
JP5	Low
JP6	High
JP7	Unconnected
JP8	Unconnected
JP9	Connected

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Table 2. Default Jumper Settings (continued)

JUMPER	DEFAULT
JP10	Connected
JP11	Connected

2.2 I^2C Interface Setup

2.2.1 External Connections

Once the jumpers are set, connect the USB-To-GPIO adapter to the PC as shown in the drawing below.

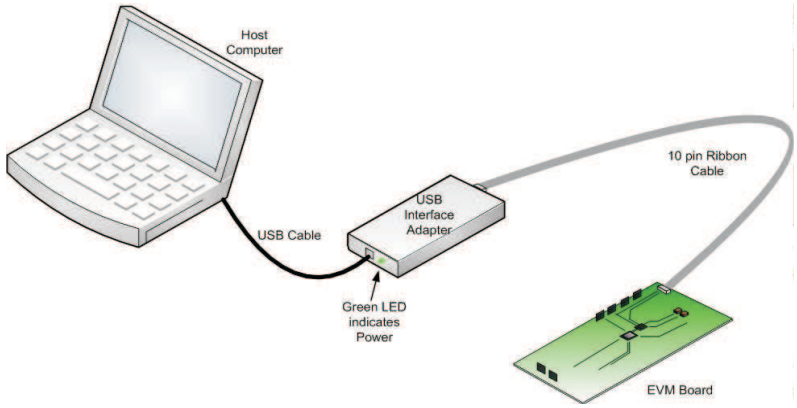


Figure 1. USB Interface Adapter Connection

Connect a positive input voltage between 2.5V and 5.5V with a minimum current capability of 1.3A.

WARNING

This EVM has white LEDs that flash with a very intense light. Eye protection and/or a diffuser to cover the LEDs during operation are recommended.

2.3 Software Setup

Either installed from the CD or downloaded from TI website, run Setup.exe and follow all the prompts to install the software. After installation, the software should automatically run.

3 EVM SOFTWARE SETUP AND OPERATION

3.1 General considerations

The EVM software running on a PC host, communicates with the device and provides access to its internal registers. First, the host checks if the USB-To-GPIO firmware version is up to date. If it is not, please download and update to the latest version. Note that after updating the firmware, the USB must be disconnected and reconnected. The same process applies to the EVM software.

3.2 Software Description

For ease of use, two user interfaces have been implemented: a simple one and a detailed one. The Setup menu permits switching from one to the other. In both interfaces, special care is taken to warn the user in case of hardware power or connection problems via indicators at the bottom of the window.

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3.2.1 Simple Interface

The simple interface shown below appears by default when running the software.

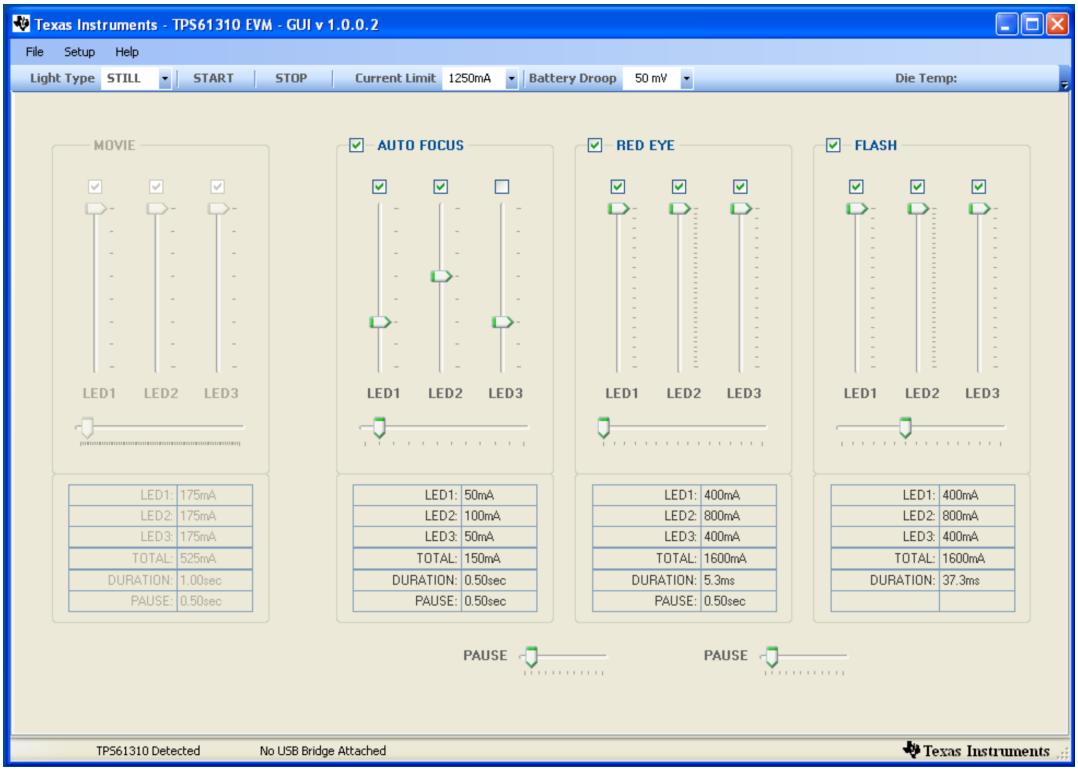


Figure 2. Simple Interface

Before starting any action, the current limit must be set after powering up the device. Once this is done, the user can choose two types of light applications. The movie type illustrates a typical DC continuous-light application such as video lighting. The still type shows a typical camera-flash application.

In both cases, the various LED parameters are easily modified by using the sliders. The battery droop is also selectable among several values.

To run and stop the chosen configuration, a START and a STOP button are provided.

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3.2.2 Detailed Interface

The second interface puts forward all the TPS61310 features through the modeling of internal registers. Figure 3 illustrates the detailed interface of the evaluation software.

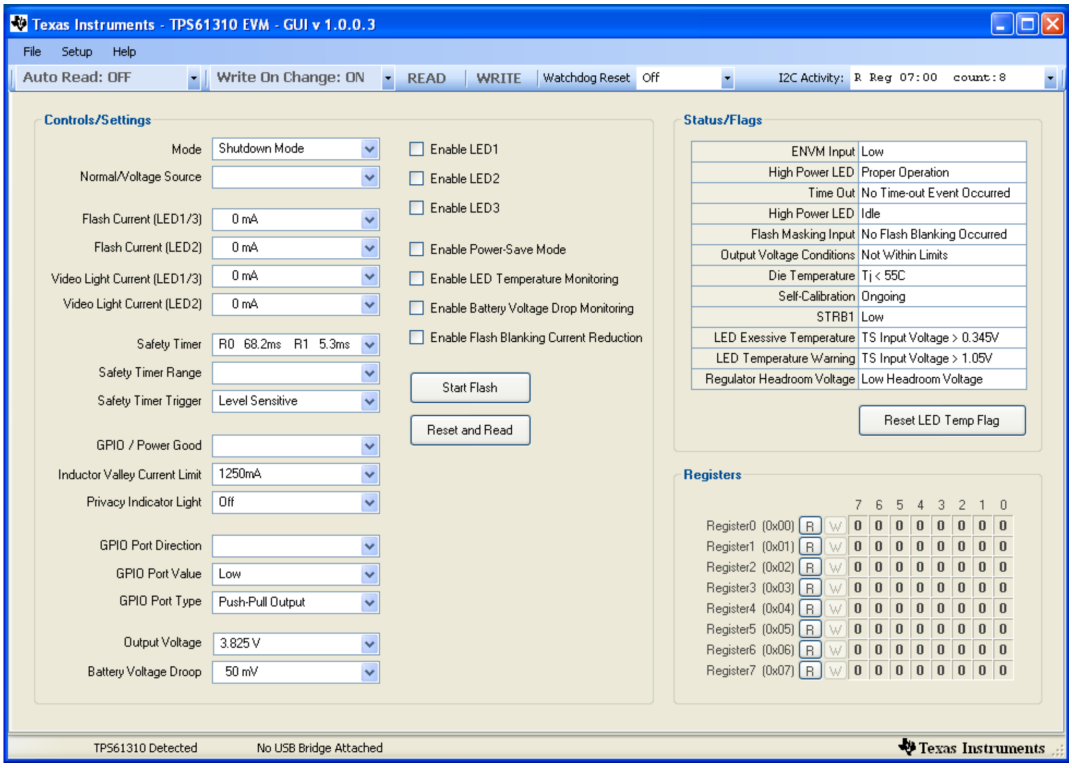


Figure 3. Detailed Interface

The toolbar allows control of parameters which are only accessible through the software. In addition to normal register Read and Write, the software has an Auto-read and a Write-On-Change function. The I^2C activity box shows the action (Read or Write), the register address and data, and the number of transfers between the host and the device. The Watchdog Reset list-box is a DC light dedicated function which is aimed at refreshing the video mode of the IC.

This interface performs no calculations or computations; it simply reads and writes to and from the IC registers through the I^2C interface.

As explained before, prior to use any features of the device, the ILIM bit must be set. Each register bits can be changed manually by clicking on the buttons corresponding to each bit in the panel, or can be changed through the drop-down boxes, check-boxes and buttons. Read-only bits are listed in the group-box Status/Flags.

The Reset and Read button writes REGISTER0[0]=1 and reads all the registers. Values shown in the table may differ from those presented in the datasheet as some bits assume two different functions in read and write operations.

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4 TEST RESULTS

4.1 Flash mode

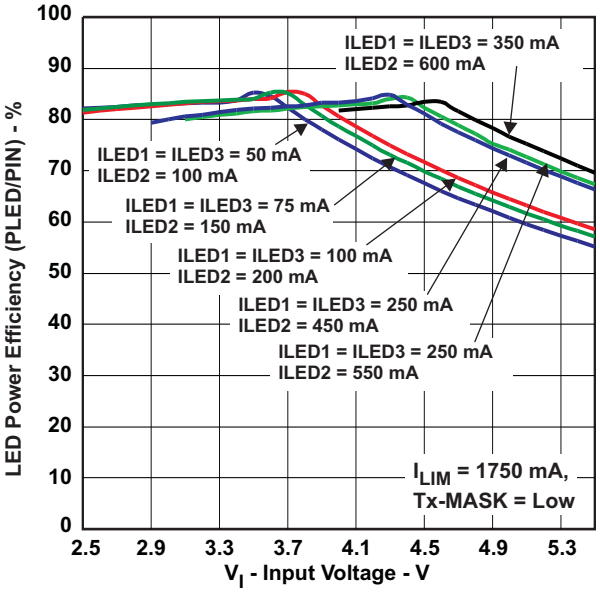


Figure 4. LED Power Efficiency vs Input Voltage

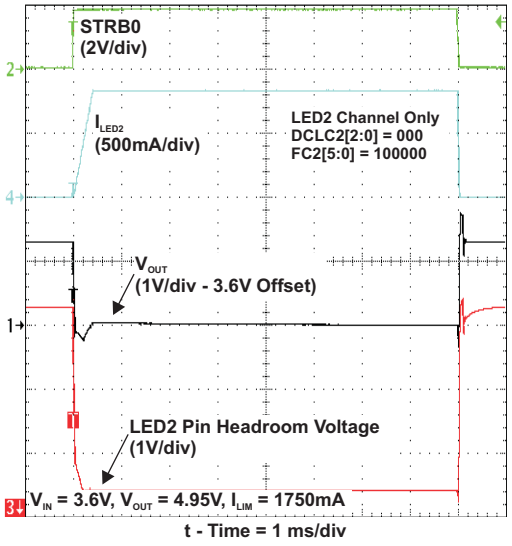


Figure 5. Flash Sequence

4.2 Video Light mode

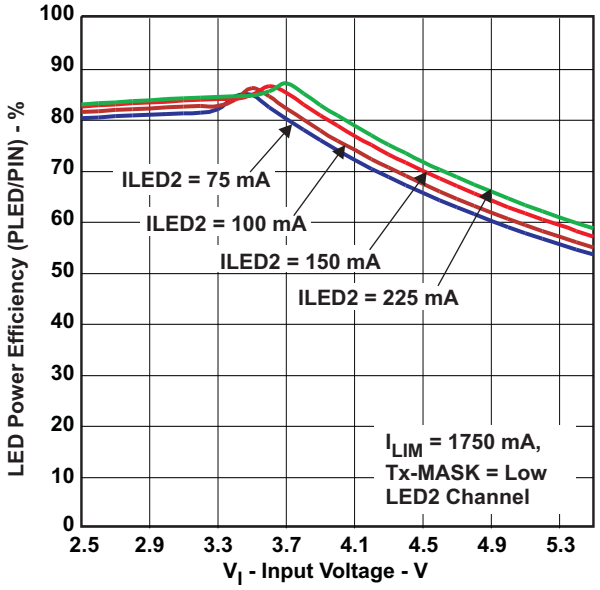


Figure 6. LED Power Efficiency vs Input Voltage

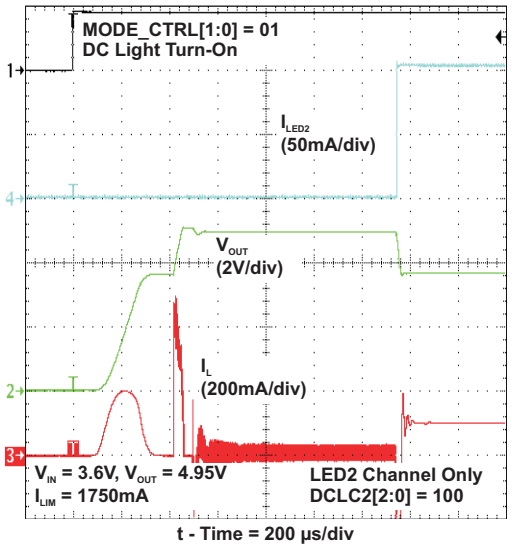


Figure 7. Video Light Startup

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4.3 Voltage Mode

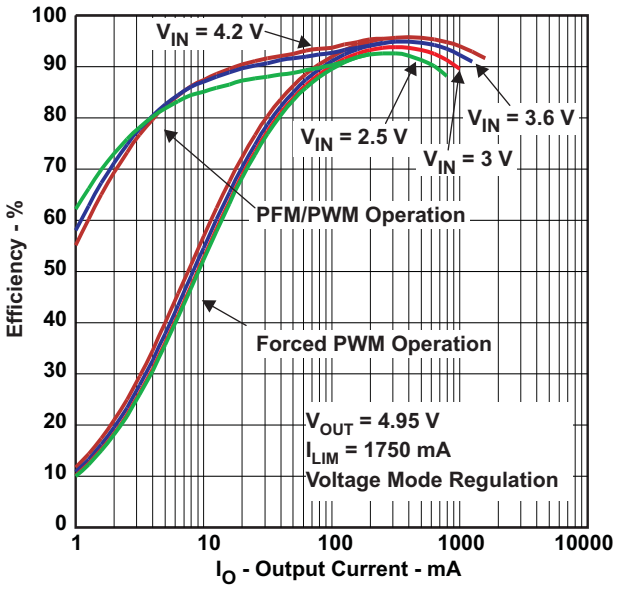


Figure 8. Efficiency vs Input Voltage

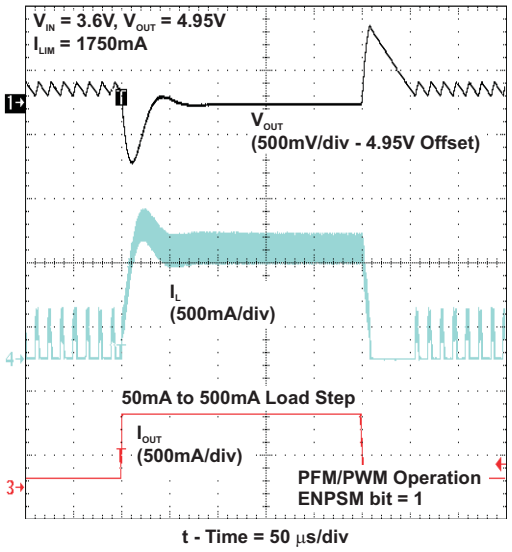


Figure 9. Load Transient

5 BOARD LAYOUT

Proper board layout is important for all high-frequency switch-mode power supplies. Figure 10 through Figure 14 show the board layout for the TPS61310EVM-638 PCB. The nodes with high switching frequencies and currents are kept as short as possible to minimize trace inductance. Careful attention has been given to the routing of high-frequency current loops. A single-point grounding scheme is used. Also, the majority of the heat sinking for this device occurs through the top layer traces and vias pulled from the IC's solder bumps that carry high currents. For specific layout guidelines, see the TPS61310 data sheet.

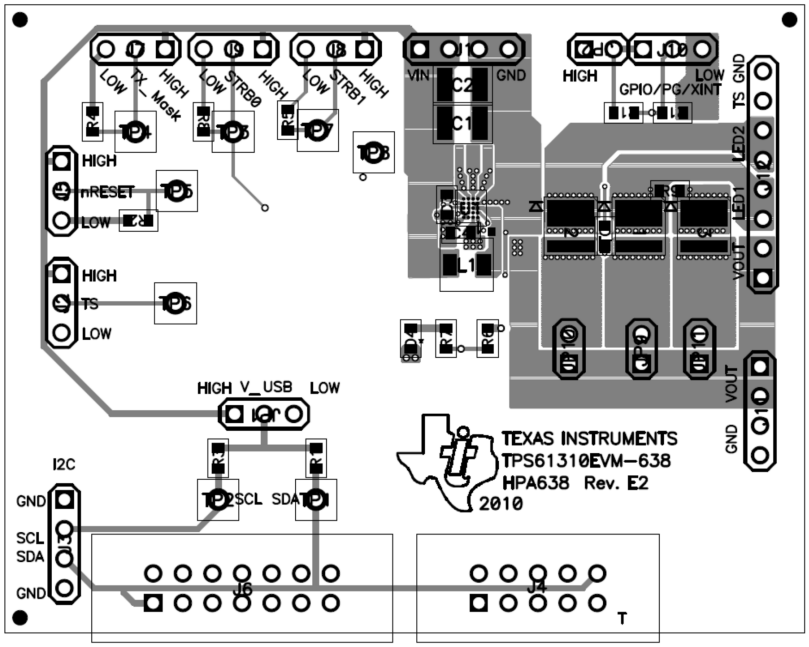


Figure 10. Assembly Layer

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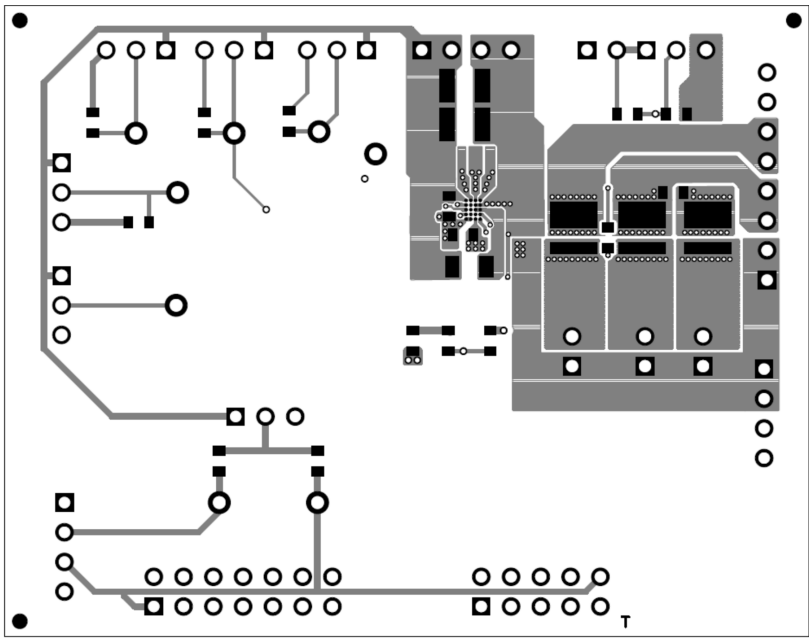


Figure 11. Top Layer

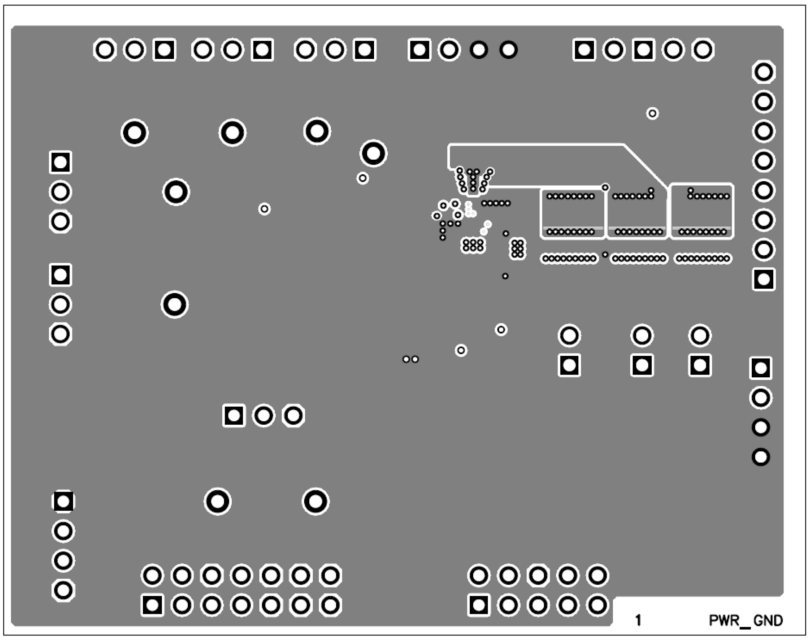


Figure 12. Layer 2

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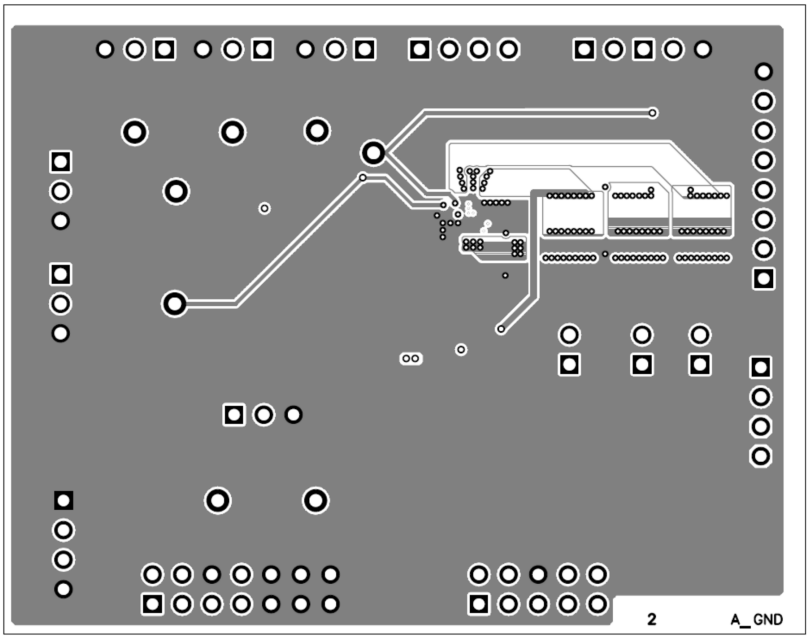


Figure 13. Layer 3

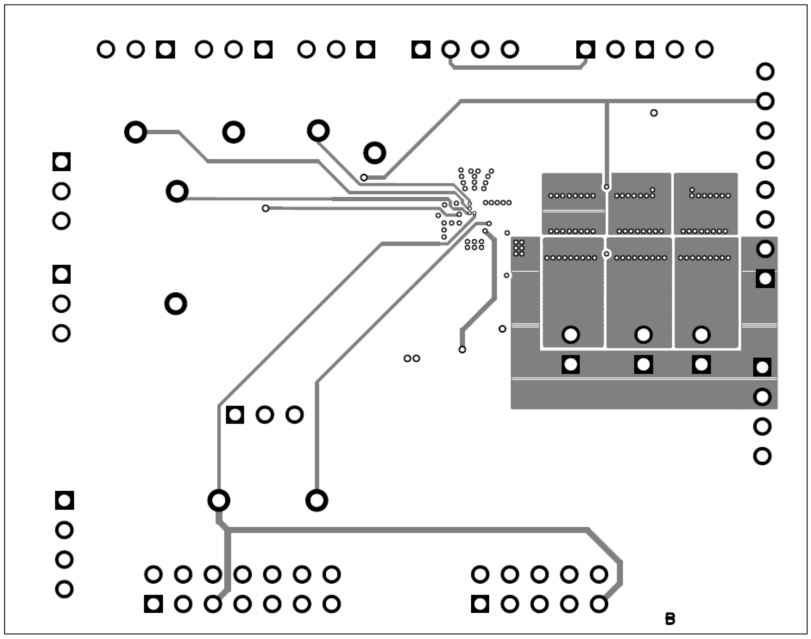


Figure 14. Bottom Layer

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6 SCHEMATICS AND BILL OF MATERIALS

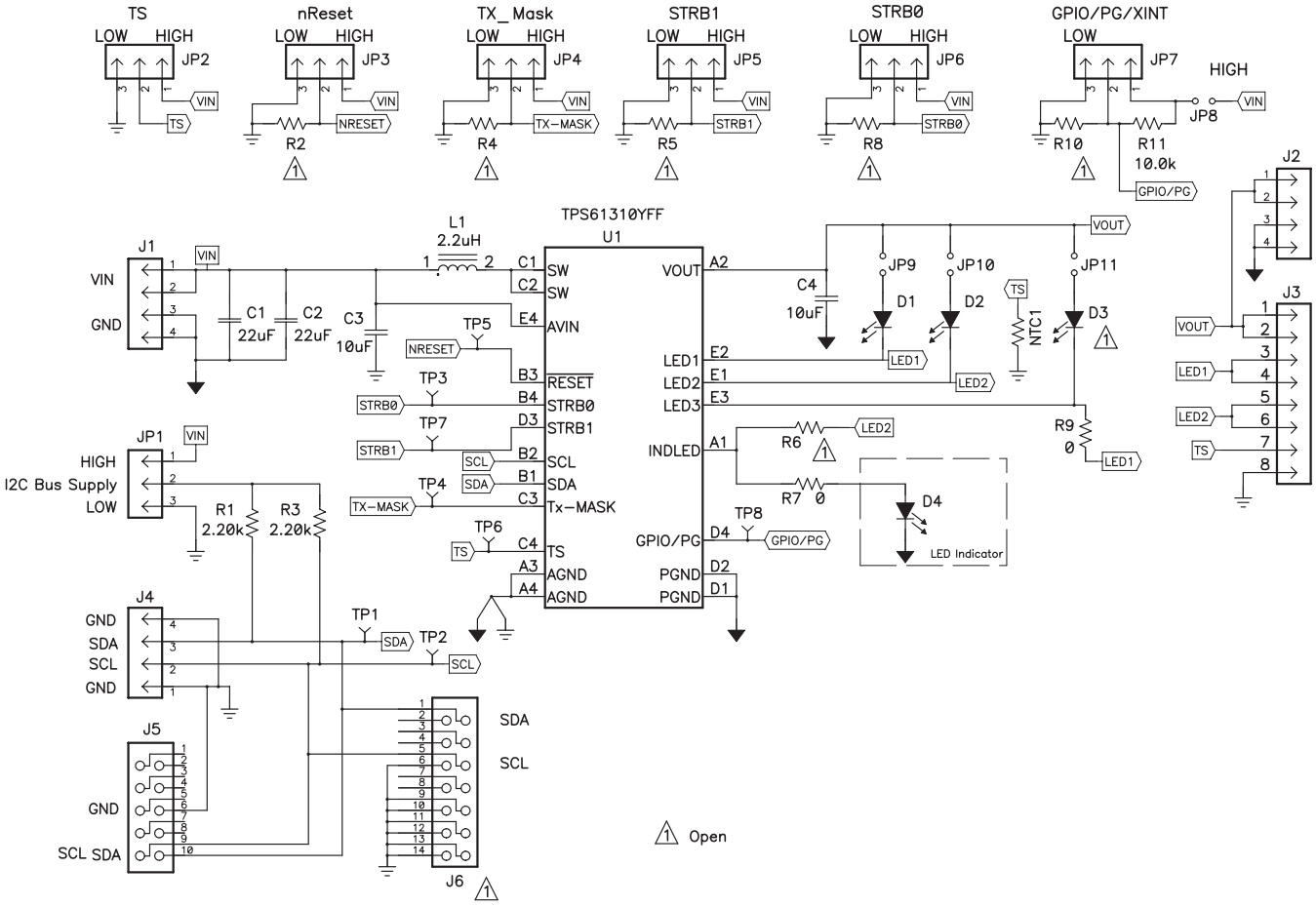


Figure 15. TPS61310EVM-638 Schematic

Table 3. TPS61310EVM-638 Bill of Materials

Qua.	Ref Des	Value	Dl	Size	Part Number	Mfr
2	C1, C2	22µF	Capacitor, Ceramic, 16V, X5R	1210	C3225X7R1C226M	TDK
2	C3, C4	10µF	Capacitor, Ceramic, 10-µF, 6.3-V, X5R, 10%	0603	C1608X5R0J106MT	TDK
2	D1, D2	CERAMOS	Diode, Flash, 1amp, V_{fwd} 3.9V	.065*.080 inch	Ceramos LWW C9EP	OSRAM
0	D3	Open	Diode, Flash, 1amp, V_{fwd} 3.9V	.065*.080 inch	Ceramos LWW C9EP	OSRAM
1	D4	LS Q976	Diode, LED, [Color], 20mA	0603	LS Q976	Osram
3	J1, J3, J11	PEC04SAAN	Header, 4-pin, 100mil spacing	0.100 x 4	PEC04SAAN	Sullins
1	J12	PEC08SAAN	Header, Male 8-pin, 100mil spacing	0.100 inch x 8	PEC08SAAN	Sullins
6	J2, J5, J7, J8, J9, J10	PEC03SAAN	Header, Male 3-pin, 100mil spacing,	0.100 inch x 3	PEC03SAAN	Sullins
1	J4	N2510-6002RB	Connector, Male Straight 2x10 pin, 100mil spacing, 4 Wall	0.338 x 0.788 inch	N2510-6002RB	3M
1	J6	N2514-6002RB	Connector, Male Straight 2x7 pin, 100mil spacing, 4 Wall	0.100 inch x 2X7	N2514-6002RB	3M
1	JP1	PEC03SAAN	Header, 3-pin, 100mil spacing	0.100 x 3	PEC03SAAN	Sullins
1	JP2	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins

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Table 3. TPS61310EVM-638 Bill of Materials (continued)

1	L1	2.2uH	Inductor, SMT	0.130 X 0.130 inch	FDSE0312-2R2M-P3	Toko
1	NTC1	NCP18WM224J03RB	Resistor, Chip, 1/16W, 5%	0603	CRCW0603-xxx-J	Vishay
2	R1, R3	2.20kΩ	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R11	10.0kΩ	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R2, R4, R5, R6, R8, R10	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R7, R9	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
8	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	5000	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	U1	TPS61310YFF	IC, High Power Multiple White LED Drive w/ I^2C Compatible Interface	DSBGA	TPS61310YFF	TI
8	–		Shunt, 100-mil, Black	0.100	929950-00	3M

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RFID	www.ti-rfid.com	Wireless	www.ti.com/wireless-apps
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